Final

Site Investigation Report
Former Probable Range, Parcel 247Q-X

Fort McClellan
Calhoun County, Alabama

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Executive Summary

In accordance with Contract Number DACA21-96-D-0018, Task Order CK10, IT Corporation completed a site investigation (SI) at the Former Probable Range, Parcel 247Q-X, at Fort McClellan in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site and, if present, whether the concentrations pose an unacceptable risk to human health or the environment. The SI at the Former Probable Range, Parcel 247Q-X, consisted of the sampling and analysis of 13 surface soil samples, 3 depositional soil samples, 13 subsurface soil samples, and 2 groundwater samples. In addition, six permanent monitoring wells were installed to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information.

Chemical analysis of samples collected at Parcel 247Q-X indicates that metals, volatile organic compounds (VOC), and semivolatile organic compounds (SVOC) were detected in the environmental media sampled. Explosive compounds were not detected in any of the samples collected at the site. To evaluate whether the detected constituents pose an unacceptable risk to human health or the environment, the analytical results were compared to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for Fort McClellan.

The potential threat to human receptors is expected to be low. Although the parcel is located within an undeveloped, wooded area of the Main Post, the analytical data were screened against residential human health SSSLs to evaluate the site for possible residential (i.e., unrestricted) land reuse. The metals that exceeded SSSLs in site media were below their respective background concentrations or were within the range of background values. VOC and SVOC concentrations in site media were below SSSLs.

Constituents of potential ecological concern are limited to two metals (barium and lead) in one surface soil sample. The barium result (523 milligrams per kilogram [mg/kg]) exceeded its ESV (165 mg/kg) and upper background range (288 mg/kg) in one of 16 surface and depositional soil samples. The lead result (288 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in the same sample. All other barium and lead results in soils (including subsurface soils) were below background or within the upper background range. Statistically, the elevated barium and lead results in one sample are not representative of nominal site-wide levels. Therefore, these metals are not expected to pose a significant threat to ecological receptors.

Based on the results of the SI, past operations at the Former Probable Range, Parcel 247Q-X, have not adversely impacted the environment. The metals and chemical constituents detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT Corporation recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at the Former Probable Range, Parcel 247Q-X.

1.0 Introduction

The U.S. Army has selected Fort McClellan (FTMC), located in Calhoun County, Alabama, for closure by the Base Realignment and Closure (BRAC) Commission under Public Laws 100-526 and 101-510. The 1990 Base Closure Act, Public Law 101-510, established the process by which U.S. Department of Defense (DOD) installations would be closed or realigned. The BRAC Environmental Restoration Program requires investigation and cleanup of federal properties prior to transfer to the public domain. The U.S. Army is conducting environmental studies of the impact of suspected contaminants at parcels at FTMC under the management of the U.S. Army Corps of Engineers (USACE), Mobile District. The USACE contracted IT Corporation (IT) to perform the site investigation (SI) at the Former Probable Range, Parcel 247Q-X, under Contract Number DACA21-96-D-0018, Task Order CK10.

This report presents specific information and results compiled from the SI, including field sampling and analysis and monitoring well installation activities conducted at the Former Probable Range, Parcel 247Q-X.

1.1 Project Description

The Former Probable Range was identified as an area to be investigated prior to property transfer. The site was classified as a Category 1 Qualified parcel in the environmental baseline survey (EBS) (Environmental Science and Engineering, Inc. [ESE], 1998). Category 1 parcels are areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas). The parcel, however, was qualified “X” because of the potential for unexploded ordnance (UXO).

A site-specific field sampling plan (SFSP) (IT, 2001a) and a site-specific safety and health plan (SSHP) were finalized in June 2001. The SFSP and SSHP were prepared to provide technical guidance for sample collection and analysis at the Former Probable Range, Parcel 247Q-X. The SFSP was used in conjunction with the SSHP as attachments to the installation-wide work plan (IT, 1998) and the installation-wide sampling and analysis plan (SAP) (IT, 2000a). The SAP includes the installation-wide safety and health plan and quality assurance plan.

The SI included fieldwork to collect 13 surface soil samples, 3 depositional soil samples, 13 subsurface soil samples, and 2 groundwater samples. Data from the field investigation were used to determine whether potential site-specific chemicals are present at the Former Probable Range, Parcel 247Q-X.

1.2 Purpose and Objectives

The SI program was designed to collect data from site media and provide a level of defensible data and information in sufficient detail to determine whether chemical constituents are present at the Former Probable Range, Parcel 247Q-X, at concentrations that pose an unacceptable risk to human health or the environment. The conclusions of the SI in Chapter 6.0 are based on the comparison of the analytical results to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. The SSSLs and ESVs were developed by IT as part of the human health and ecological risk evaluations associated with SIs being performed under the BRAC Environmental Restoration Program at FTMC. The SSSLs and ESVs are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000b). Background metals screening values are presented in the *Final Background Metals Survey Report*, *Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Based on the conclusions presented in this SI report, the BRAC Cleanup Team will decide either to propose “No Further Action” at the site or to conduct additional work at the site.

1.3 Site Description and History

The Former Probable Range, Parcel 247Q-X, is located in the southwestern corner of the FTMC Main Post (Figure 1-1). The probable range was identified in the Environmental Photographic Interpretation Center report (U.S. Environmental Protection Agency [EPA], 1990); however, the range was not observed on any maps reviewed during the EBS, nor was it reported in the *Archives Search Report* (USACE, 2001). In a 1961 aerial photograph, the parcel appears as an unaltered, heavily wooded, roughly 40-acre area. Aerial photographs from 1969 depict the first appearance of the probable range as a U-shaped clearing in the center of the parcel. Aerial photographs from 1976, 1982, 1994, and 1998 show that, over time, the size of the cleared area changed. The site appears most used in the 1969 aerial photograph. Currently, the site appears as an elongated clearing oriented northeast-southwest (Figure 1-2).

The direction of fire at the probable range would have been either to the southwest or to the northeast. Because of the range’s orientation and proximity to inhabited/developed areas, it is unlikely that the range was used for firing weapons. Therefore, it is believed that the range was actually used for other training activities (ESE, 1998).

The types of training aids that may have been used at the Former Probable Range, Parcel 247Q-X, were noted during a site walk conducted by IT and USACE-Huntsville personnel in January

2001 (USACE-Huntsville Center, 2001; IT, 2001b). During the site walk the following items were observed:

- A 40-millimeter smoke grenade
- Several items tentatively identified as spent smoke grenades and flares
- A gas mask cartridge tentatively identified as a component of an M17 gas mask
- Numerous drums (55-gallon and smaller) in varying states of deterioration.

Throughout the area, there appeared to be drum debris on and just below the ground surface. One 55-gallon drum was observed to have reinforced ribs. Another drum, found in good condition, was marked with the words “simulator-atomic.” Numerous depressions were observed around the drums, and to the northwest several mounds were located along the side of a hill.

Also during the site walk, two shallow trenches were discovered in the northeastern area of the parcel (Figure 1-2). The trenches were approximately 4 feet wide by 40 feet long and were slightly wider at one end. The walls of the trenches were lined with both intact and dismantled wall lockers and filing cabinets (USACE-Huntsville Center, 2001; IT, 2001b).

2.0 Previous Investigations

An EBS was conducted by ESE to document current environmental conditions of all FTMC property (ESE, 1998). The study was to identify sites that, based on available information, have no history of contamination and comply with DOD guidance for fast-track cleanup at closing installations. The EBS also provides a baseline picture of FTMC properties by identifying and categorizing the properties by seven criteria:

1. Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas).

2. Areas where only release or disposal of petroleum products has occurred.

3. Areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require a removal or remedial response.

4. Areas where release, disposal, and/or migration of hazardous substances has occurred, and all removal or remedial actions to protect human health and the environment have been taken.

5. Areas where release, disposal, and/or migration of hazardous substances has occurred, and removal or remedial actions are underway, but all required remedial actions have not yet been taken.

6. Areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.

7. Areas that are not evaluated or require additional evaluation.

For non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) environmental or safety issues, the parcel label includes the following components: a unique non-CERCLA issue number, the letter "Q" designating the parcel as a Community Environmental Response Facilitation Act (CERFA) Category 1 Qualified parcel, and the code for the specific non-CERCLA issue(s) present (ESE, 1998). The non-CERCLA issue codes used are:

- A = Asbestos (in buildings)
- L = Lead-Based Paint (in buildings)
- P = Polychlorinated Biphenyls
- R = Radon (in buildings)
- RD = Radionuclides/Radiological Issues
- X = Unexploded Ordnance
- CWM = Chemical Warfare Material.

The EBS was conducted in accordance with CERFA protocols (CERFA Public Law 102-426) and DOD policy regarding contamination assessment. Record searches and reviews were performed on all reasonably available documents from FTMC, the Alabama Department of Environmental Management (ADEM), EPA Region 4, and Calhoun County, as well as a database search of CERCLA-regulated substances, petroleum products, and Resource Conservation and Recovery Act-regulated facilities. Available historical maps and aerial photographs were reviewed to document historical land uses. Personal and telephone interviews of past and present FTMC employees and military personnel were conducted. In addition, visual site inspections were conducted to verify conditions of specific property parcels.

Parcel 247Q-X was categorized as a CERFA Category 1 Qualified parcel in the EBS. Category 1 parcels are areas where no known or recorded storage, release, or disposal (including migration) of hazardous substances or petroleum products has occurred. However, the parcel was qualified for potential UXO because of possible range activities conducted at the site. Therefore, the parcel required additional evaluation to determine its environmental condition.

3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by IT at the Former Probable Range, Parcel 247Q-X, including UXO avoidance, environmental sampling and analysis, and groundwater monitoring well installation activities.

3.1 UXO Avoidance

UXO avoidance was performed at the Former Probable Range, Parcel 247Q-X, following methodology outlined in Section 4.1.7 of the SAP (IT, 2000a). IT UXO personnel used a low-sensitivity magnetometer to perform a surface sweep of the parcel prior to site access. After the parcel was cleared for access, sample locations were monitored following procedures outlined in Section 4.1.7.3 of the SAP (IT, 2000a).

3.2 Environmental Sampling

The environmental sampling performed during the SI at the Former Probable Range, Parcel 247Q-X, included the collection of surface and depositional soil samples, subsurface soil samples, and groundwater samples for chemical analysis. The sample locations were determined by observing site physical characteristics during a site walkover and by reviewing historical aerial photographs and documents. The sample locations, media, and rationale are summarized in Table 3-1. Sampling locations are shown on Figure 3-1. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.4. IT contracted Environmental Services Network, Inc, a direct-push technology (DPT) subcontractor, to assist in surface and subsurface soil sample collection.

3.2.1 Surface and Depositional Soil Sampling

Surface soil samples were collected from 13 locations and depositional soil samples were collected from three locations at the Former Probable Range, Parcel 247Q-X, as shown on Figure 3-1. Soil sampling locations and rationale are presented in Table 3-1. Sample designations and analytical parameters are listed in Table 3-2. Soil sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Surface soil samples were collected from the uppermost foot of soil using a DPT sampling system, following the methodology specified in Section 4.9.1.1 of the SAP (IT, 2000a). Depositional soil samples were collected from the uppermost six inches of soil with a stainless-steel spoon. Surface and depositional soil samples were collected by first removing surface debris (e.g., rocks and vegetation) from the immediate sample area. The soil was collected with the sampling device and screened with a photoionization detector (PID) in accordance with Section 4.7.1.1 of the SAP (IT, 2000a). The soil fraction for volatile organic compound (VOC) analysis was then immediately collected using three EnCore® samplers. The remaining portion of soil was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected from 13 soil borings at the Former Probable Range, Parcel 247Q-X, as shown on Figure 3-1. Sampling locations and rationale are presented in Table 3-1. Subsurface soil sample designations, depths, and analytical parameters are listed in Table 3-2. Soil boring locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than one foot below ground surface (bgs) in the unsaturated zone. The soil borings were advanced and samples collected using the DPT sampling procedures specified in Section 4.9.1.1 of the SAP (IT, 2000a). Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

Subsurface soil samples were collected continuously to 12 feet bgs or until DPT sampler refusal was encountered. Samples were field screened using a PID in accordance with Section 4.7.1.1 of the SAP (IT, 2000a) to measure for volatile organic vapors. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were not greater than background, the deepest sample interval above the saturated zone was submitted for analysis. Samples for VOC analysis were collected directly from the sampler using three EnCore samplers. The remaining portion of soil was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring. The boring logs are included in Appendix B. At the completion of soil sampling, boreholes were abandoned with bentonite pellets and hydrated with potable water, following borehole abandonment procedures summarized in Appendix B of the SAP (IT, 2000a).

3.2.3 Monitoring Well Installation

Six permanent groundwater monitoring wells were installed at the Former Probable Range, Parcel 247Q-X, to collect groundwater samples for laboratory analysis. However, only two of the wells produced sufficient groundwater for sampling. The well locations are shown on Figure 3-1. Table 3-3 summarizes construction details of the wells installed at the Former Probable Range, Parcel 247Q-X. The well construction logs are included in Appendix B.

IT contracted Miller Drilling, Inc. to install the permanent wells with a hollow-stem auger rig at six of the DPT soil boring locations. However, at four locations this was not possible because of hollow-stem auger refusal or drill rig access issues. Therefore, at these locations, the well was offset approximately 30 to 90 feet from the DPT soil boring location. The wells were installed following procedures outlined in Section 4.7 and Appendix C of the SAP (IT, 2000a). The borehole at each well location was advanced with a 4.25-inch inside diameter (ID) hollow-stem auger from ground surface to the saturated zone. The borehole was augered to the completion depth of the DPT soil boring, and samples were collected from that depth to the bottom of the borehole. A 2-foot-long, 2-inch ID carbon steel split-spoon sampler was driven at 5-foot intervals to collect residuum for observing and describing lithology. Where split-spoon refusal was encountered, the auger was advanced until the first water-bearing zone was encountered. The on-site geologist logging the auger borehole continued the lithological log for each borehole from the depth of the split-spoon sampler refusal to the bottom of the auger borehole by logging the auger drill cuttings. The drill cuttings were logged to determine lithologic changes and the approximate depth of groundwater encountered during drilling. This information was used to determine the optimal placement of the monitoring well screen interval and to provide site-specific geological and hydrogeological information. The boring log for each borehole is included in Appendix B.

Upon reaching the target depth in each borehole, a 10- or 15-foot length of 2-inch ID, 0.010-inch continuous slot, Schedule 40 polyvinyl chloride (PVC) screen with a 3-inch PVC end cap was placed through the auger to the bottom of the borehole. The screen and end cap were attached to 2-inch ID, flush-threaded Schedule 40 PVC riser. A filter pack consisting of number 1 filter sand (environmentally safe, clean fine sand, sieve size 20 to 40) was tremied around the well screen to approximately 3 feet above the top of the well screen as the augers were removed. A bentonite seal, consisting of approximately 3 feet of bentonite pellets, was placed immediately on top of the filter pack and hydrated with potable water. At wells where the bentonite seal was installed below the water table surface, the bentonite pellets were allowed to hydrate in the groundwater. The bentonite seal placement and hydration followed procedures in Appendix C of the SAP (IT, 2000a). Bentonite-cement grout was tremied into the remaining annular space of the well. A protective steel casing was installed around the top PVC well casing, and a concrete pad was constructed around the well head.

IT attempted to develop monitoring wells HR-247Q-MW02, HR-247Q-MW03, and HR-247Q-MW05; however, these wells produced very little water. The remaining wells could not be developed because they were dry. Monitoring well HR-247Q-MW02 was developed using a polyethylene bailer. Monitoring well HR-247Q-MW05 was developed by surging and pumping with a 2-inch-diameter submersible pump in accordance with methodology outlined in Section 4.8 and Appendix C of the SAP (IT, 2000a). The submersible pump used for well development was moved in an up-and-down fashion to encourage any residual well installation materials to enter the well. These materials were then pumped out of the well in order to re-establish the natural hydraulic flow conditions. Monitoring well HR-247Q-MW03 was developed using a combination of bailing and surging/pumping. Development was performed until the wells had been pumped/bailed dry three times or, in the case of HR-247Q-MW03, until the site manager deemed development complete. The well development logs are included in Appendix C.

3.2.4 Water Level Measurements

The depth to groundwater was measured in monitoring wells at the site on three occasions: November 2001, January 2002, and February 2002. Most of the wells produced little or no water. Water levels were measured following procedures outlined in Section 4.18 of the SAP (IT, 2000a). Depth to groundwater was measured with an electronic water level meter. The meter probe and cable were cleaned before use at each well, following decontamination methodology presented in Section 4.10 of the SAP (IT, 2000a). Measurements were referenced to the top of the PVC well casing. A summary of groundwater level measurements for the Former Probable Range, Parcel 247Q-X, is presented in Table 3-4.

3.2.5 Groundwater Sampling

Groundwater samples were collected from two of the six monitoring wells installed at the Former Probable Range, Parcel 247Q-X. The remaining wells did not produce sufficient groundwater for sampling. The well/groundwater sampling locations are shown on Figure 3-1. The sampling locations and rationale are listed in Table 3-1. Sample designations and analytical parameters are listed in Table 3-5.

Sample Collection. Groundwater samples were collected using a peristaltic pump equipped with Teflon™ tubing, following the procedures outlined in Section 4.9.1.4 of the SAP (IT, 2000a). Groundwater samples were collected after purging a minimum of three well volumes and after field parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) stabilized. Field parameters were measured using a calibrated water-quality meter, as summarized in Table 3-6. Sample collection logs are included in

Appendix A. The samples were analyzed for the parameters listed in Table 3-5 using methods outlined in Section 3.4.

3.3 Surveying of Sample Locations

Monitoring well and sample locations were surveyed using global positioning system survey techniques described in Section 4.3 of the SAP and conventional civil survey techniques described in Section 4.19 of the SAP (IT, 2000a). Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983. Elevations were referenced to the North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.4 Analytical Program

Samples collected during the SI were analyzed for various chemical parameters based on potential site-specific chemicals and on EPA, ADEM, FTMC, and USACE requirements. Samples collected at the Former Probable Range, Parcel 247Q-X, were analyzed for the following parameters:

- Target analyte list metals – EPA Method 6010B/7000
- Target compound list VOCs – EPA Method 8260B
- Target compound list semivolatile organic compounds (SVOC) – EPA Method 8270C
- Nitroaromatic and nitramine explosives – EPA Method 8330.

The samples were analyzed using EPA SW-846 methods, including Update III Methods where applicable, as presented in Table 6-1 in Appendix B of the SAP (IT, 2000a).

3.5 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging, and shipping followed requirements specified in Section 4.13.2 of the SAP (IT, 2000a). Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SI are listed in Table 5-1 of Appendix B of the SAP (IT, 2000a). Sample documentation and chain-of-custody records were completed as specified in Section 4.13 of the SAP (IT, 2000a).

Completed analysis request and chain-of-custody records (Appendix A) were secured and included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.6 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in Appendix D of the SAP (IT, 2000a). The IDW generated during the SI at the Former Probable Range, Parcel 247Q-X, was segregated as follows:

- Drill cuttings
- Purge water from well development, sampling activities, and decontamination fluids
- Personal protective equipment.

Solid IDW was stored inside the fenced area surrounding Buildings 335 and 336 in lined roll-off bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analyses. Based on the results, drill cuttings and personal protective equipment generated during the SI were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was contained in the 20,000-gallon sump associated with the Building T-338 vehicle washrack. Liquid IDW was characterized by VOC, SVOC, and metals analyses. Based on the analyses, liquid IDW was discharged as nonregulated waste to the FTMC wastewater treatment plant on the Main Post.

3.7 Variances/Nonconformances

Five variances to the SFSP were recorded during completion of the SI at the Former Probable Range, Parcel 247Q-X. The variances did not alter the intent of the investigation or the sampling rationale presented in the SFSP. The variances are summarized in Table 3-7. Variance reports are presented in Appendix E. No nonconformances were recorded during completion of the SI.

3.8 Data Quality

The field sample analytical data are presented in tabular form in Appendix F. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of Appendix B of the SAP [IT, 2000a]). Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms.

Data Validation. The reported analytical data were validated in accordance with EPA National Functional Guidelines by Level III criteria. The data validation results are summarized in a quality assurance report, which includes the data validation summary report (Appendix G). Selected results were qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC IT Environmental Management System database for tracking and reporting. The qualified data were used in comparisons to the SSSLs and ESVs developed by IT. Rejected data (assigned an “R” qualifier) were not used in the comparisons with the SSSLs and ESVs. The data presented in this report, except where qualified, meet the principle data quality objective for this SI.

4.0 Site Characterization

Subsurface investigations performed at the Former Probable Range, Parcel 247Q-X, provided soil, bedrock, and groundwater data used to characterize the geology and hydrogeology of the site.

4.1 Regional and Site Geology

4.1.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992) and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984) but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper, undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish gray siltstone and mudstone. Massive to laminated greenish gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east, and southwest of the Main Post and consists of interlayered bluish gray or pale yellowish gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline, porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post, as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish red-purple mudstone, shale, siltstone, and greenish red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark gray, finely to coarsely crystalline, medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum

(Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone is comprised of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped as undifferentiated at FTMC and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites, and limestones and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Osborne et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark to light gray limestone with abundant chert nodules and greenish gray to grayish red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale based on fossil data.

The Pennsylvanian Parkwood Formation overlies the Floyd Shale and consists of a medium to dark gray, silty, clay shale and mudstone with interbedded light to medium gray, very fine to fine grained, argillaceous, micaceous sandstone. Locally the Parkwood Formation also contains beds of medium to dark gray, argillaceous, bioclastic to cherty limestone and beds of clayey coal up to a few inches thick (Raymond et al., 1988). The Parkwood Formation in Calhoun County is generally found within a structurally complex area known as the Coosa deformed belt. In the deformed belt, the Parkwood Formation and Floyd Shale are mapped as undifferentiated because their lithologic similarity and significant deformation make it impractical to map the contact (Thomas and Drahovzal, 1974; Osborne et al., 1988). The undifferentiated Parkwood Formation and Floyd Shale are found throughout the western quarter of Pelham Range.

The Jacksonville thrust fault is the most significant structural geologic feature in the vicinity of the Main Post of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama, and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence that makes up the Eden thrust sheet is exposed at FTMC through an eroded window, or fenster, in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation; north by the Conasauga Formation; northeast, east, and southwest by the Shady Dolomite; and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). Two small klippen of the Shady Dolomite, bounded by the Jacksonville fault, have been recognized adjacent to the Pell City fault at the FTMC window (Osborne et al., 1997).

The Pell City fault serves as a fault contact between the bedrock within the FTMC window and the Rome and Conasauga Formations. The trace of the Pell City fault is also exposed approximately nine miles west of the FTMC window on Pelham Range, where it traverses northeast to southwest across the western quarter of Pelham Range. Here, the trace of the Pell City fault marks the boundary between the Pell City thrust sheet and the Coosa deformed belt.

The eastern three-quarters of Pelham Range is located within the Pell City thrust sheet, while the remaining western quarter of Pelham is located within the Coosa deformed belt. The Pell City thrust sheet is a large-scale thrust sheet containing Cambrian and Ordovician rocks and is relatively less structurally complex than the Coosa deformed belt (Thomas and Neathery, 1982). The Pell City thrust sheet is exposed between the traces of the Jacksonville and Pell City faults along the western boundary of the FTMC window and along the trace of the Pell City fault on Pelham Range (Thomas and Neathery, 1982; Osborne et al., 1988). The Coosa deformed belt is a narrow northeast-to-southwest-trending linear zone of complex structure (approximately 5 to

20 miles wide and approximately 90 miles in length) consisting mainly of thin imbricate thrust slices. The structure within these imbricate thrust slices is often internally complicated by small-scale folding and additional thrust faults (Thomas and Drahovzal, 1974)

4.1.2 Site Geology

Soils at the Former Probable Range, Parcel 247Q-X, are categorized as the Stony Rough Land Sandstone (U. S. Department of Agriculture [USDA], 1961). This miscellaneous land type consists of rough, mountainous areas with many outcrops of sandstone and quartzite bedrock, loose rock fragments, and scattered patches of sandy soil material.

The Stony Rough Land Sandstone consists of well-drained, shallow or stony, friable, medium to strongly acidic soils. Slopes generally are more than 25 percent. Erosion has been slight to severe, and some of the slopes have lost all of their original surface soil. The soil material is generally shallow over bedrock. Runoff is high, permeability is moderate to rapid, infiltration is slow, and the capacity for available moisture is low (USDA, 1961).

Descriptions of the soils from the DPT and hollow-stem auger borings revealed that soils beneath the Former Probable Range, Parcel 247Q-X, are predominately red-orange-yellow clays with some silt and sand. DPT refusal was encountered at depths ranging from 3 feet bgs to greater than 12 feet bgs.

The bedrock underlying the Former Probable Range, Parcel 247Q-X, is mapped as the Cambrian Chilhowee Group. This group of rocks is the basal unit of the sedimentary sequence in Calhoun County and consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984). These four formations are undifferentiated in part. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish gray siltstone and mudstone. Massive to laminated greenish gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

During monitoring well installation activities at the Former Probable Range, Parcel 247Q-X, hollow-stem auger refusal was encountered on a quartz-rich sandstone at HR-247Q-MW01, HR-247Q-MW04, and HR-247Q-MW06 at 19, 25, and 35 feet bgs, respectively.

4.2 Site Hydrology

4.2.1 Surface Hydrology

Precipitation in the form of rainfall averages about 53 inches annually in Anniston, Alabama, with infiltration rates annually exceeding evapotranspiration rates (U.S. Department of Commerce, 1998). The major surface water features at the Main Post of FTMC include Remount Creek, Cane Creek, and Cave Creek. These waterways flow in a general northwest to westerly direction towards the Coosa River on the western boundary of Calhoun County.

Elevation of the Former Probable Range, Parcel 247Q-X, ranges from approximately 1,075 to 1,250 feet above mean sea level. Surface drainage at the site follows site topography and generally flows in a northwesterly direction to intermittent streams. The intermittent streams feed into tributaries, which flow within the Choccolocco watershed and eventually into the Coosa River.

4.2.2 Hydrogeology

During soil boring and well installation activities, groundwater was encountered at depths ranging from approximately 15 to 30 feet bgs (Appendix B). Three of the wells were installed on top of bedrock without encountering water (HR-247Q-MW01, HR-247Q-MW04 and HR-247Q-MW06). Although groundwater was present in the remaining three wells, the elevation of the water table appears sporadic. Based on the limited groundwater elevation data collected at the site (Table 3-4), it appears that the water table has a component of flow in a northerly direction, following the topography and direction of surface water flow.

5.0 Summary of Analytical Results

The results of the chemical analyses of samples collected at the Former Probable Range, Parcel 247Q-X, indicate that metals and VOCs were detected in the various site media. In addition, one SVOC was detected in one depositional soil sample. Explosive compounds were not detected in any of the samples collected. To evaluate whether the detected constituents present an unacceptable risk to human health or the environment, the analytical results were compared to the human health SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC.

Metals concentrations exceeding the SSSLs and ESVs were subsequently compared to metals background screening values to determine if the metals concentrations are within background concentrations (SAIC, 1998). Summary statistics for background metals samples collected at FTMC are included in Appendix H.

Six compounds were quantified by both SW-846 Method 8260B (as VOCs) and Method 8270C (as SVOCs), including 1,2,4-trichlorobenzene, 1,4-dichlorobenzene, 1,3-dichlorobenzene, 1,2-dichlorobenzene, hexachlorobutadiene, and naphthalene. Method 8260B yields a reporting limit (RL) of 0.005 milligrams per kilogram (mg/kg), while Method 8270C has an RL of 0.330 mg/kg, which is typical for a soil matrix sample. Because of the direct nature of the Method 8260B analysis and its resulting lower RL, this method should be considered superior to Method 8270C when quantifying low levels (0.005 to 0.330 mg/kg) of these compounds. Method 8270C and its associated methylene chloride extraction step is superior, however, when dealing with samples that contain higher concentrations (greater than 0.330 mg/kg) of these compounds. Therefore, all data were considered and none were categorically excluded. Data validation qualifiers were helpful in evaluating the usability of data, especially if calibration, blank contamination, precision, or accuracy indicator anomalies were encountered. The validation qualifiers and concentrations reported (e.g., whether concentrations were less than or greater than 0.330 mg/kg) were used to determine which analytical method was likely to return the more accurate result.

The following sections and Tables 5-1 through 5-3 summarize the results of the comparison of detected constituents to the SSSLs, ESVs, and background screening values. Complete analytical results are presented in Appendix F.

5.1 Surface and Depositional Soil Analytical Results

Thirteen surface soil samples and three depositional soil samples were collected for chemical analyses at the Former Probable Range, Parcel 247Q-X. Surface and depositional soil samples were collected from the uppermost foot of soil at the locations shown on Figure 3-1. Metals, VOCs, and one SVOC were detected in surface and depositional soils. Analytical results were compared to residential human health SSSLs, ESVs, and metals background screening values, as presented in Table 5-1.

Metals. Twenty metals were detected in surface and depositional soil samples collected at the site. The concentrations of six metals (aluminum, arsenic, iron, manganese, thallium, and vanadium) exceeded SSSLs. With the exception of manganese and vanadium in one sample (HR-247Q-GP03), the concentrations of these metals were below their respective background concentrations. The manganese and vanadium results, however, were within the range of background values (Appendix H).

Ten metals were detected at concentrations exceeding ESVs: aluminum, barium, chromium, cobalt, iron, lead, manganese, selenium, thallium, and vanadium. Of these metals, barium (at HR-247Q-GP03 and HR-247Q-GP07), cobalt (HR-247Q-GP03), lead (HR-247Q-GP03), manganese (HR-247Q-GP03), selenium (HR-247Q-GP02 and HR-247Q-GP05), and vanadium (HR-247Q-GP03) also exceeded their respective background concentrations. With the exception of barium and lead in one sample, the metals results that exceeded ESVs were within the range of background values (Appendix H). Barium (523 mg/kg) exceeded its ESV (165 mg/kg) and upper background range (288 mg/kg) in sample HR-247Q-GP03; lead (288 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in the same sample.

Volatile Organic Compounds. Five VOCs (2-butanone, acetone, dichlorodifluoromethane, methylene chloride, and trichlorofluoromethane) were detected in surface and depositional soil samples. The methylene chloride results and all but one of the trichlorofluoromethane results were flagged with a "B" qualifier, signifying that these compounds were also detected in an associated laboratory or field blank sample. VOC concentrations in the surface and depositional soil samples ranged from 0.001 to 0.3 mg/kg and were below SSSLs and ESVs.

Semivolatile Organic Compounds. One SVOC (diethyl phthalate) was detected in one depositional soil sample (HR-247Q-DEP03) at a concentration below its SSSL and ESV.

5.2 Subsurface Soil Analytical Results

Thirteen subsurface soil samples were collected for chemical analyses at the Former Probable Range, Parcel 247Q-X. Subsurface soil samples were collected at depths greater than one foot bgs at the locations shown on Figure 3-1. Metals and VOCs were detected in subsurface soils. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-2.

Metals. Nineteen metals were detected in subsurface soil samples collected at the site. The concentrations of five metals (aluminum, arsenic, iron, manganese, and thallium) exceeded SSSLs. With the exception of manganese (at HR-247Q-MW06) and thallium (HR-247Q-GP06 and HR-247Q-MW06), the concentrations of these metals were below their respective background concentrations. The manganese and thallium results, however, were within their respective upper background ranges (Appendix H).

Volatile Organic Compounds. Three VOCs (acetone, methylene chloride, and trichlorofluoromethane) were detected in subsurface soil samples. The methylene chloride results and one trichlorofluoromethane result were flagged with a “B” qualifier, signifying that these compounds were also detected in an associated laboratory or field blank sample. VOC concentrations in the subsurface soil samples ranged from 0.0016 to 0.045 mg/kg and were below SSSLs.

5.3 Groundwater Analytical Results

Two groundwater samples were collected for chemical analysis at the Former Probable Range, Parcel 247Q-X, at the locations shown on Figure 3-1. Metals and one VOC were the only detected constituents in groundwater. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-3.

Metals. Eleven metals were detected in groundwater samples collected at the site. With the exception of manganese in one sample (HR-247Q-MW05), the metals concentrations were below SSSLs. The manganese result, however, was below its background concentration.

Volatile Organic Compounds. One VOC (methylene chloride) was detected in one groundwater sample at a concentration below its SSSL.

6.0 Summary, Conclusions, and Recommendations

Under contract to the USACE, IT completed an SI at the Former Probable Range, Parcel 247Q-X, at FTMC in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site at concentrations that pose an unacceptable risk to human health or the environment. The SI consisted of the sampling and analysis of 13 surface soil samples, 3 depositional soil samples, 13 subsurface soil samples, and 2 groundwater samples. In addition, six permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information. However, four of the six wells did not produce sufficient water for sampling.

Chemical analysis of samples collected at Parcel 247Q-X indicates that metals, VOCs, and SVOCs were detected in the environmental media sampled. Explosive compounds were not detected in any of the samples collected at the site. Analytical results were compared to the SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC. Additionally, metals concentrations exceeding SSSLs and ESVs were compared to media-specific background screening values (SAIC, 1998).

The potential threat to human receptors is expected to be low. Although the parcel is located within an undeveloped, wooded area of the Main Post, the analytical data were screened against residential human health SSSLs to evaluate the site for possible residential (i.e., unrestricted) land reuse. The metals that exceeded SSSLs in site media were below their respective background concentrations or were within the range of background values. VOC and SVOC concentrations in site media were below SSSLs.

Constituents of potential ecological concern are limited to two metals (barium and lead) in one surface soil sample. The barium result (523 mg/kg) exceeded its ESV (165 mg/kg) and upper background range (288 mg/kg) in one of 16 surface and depositional soil samples. The lead result (288 mg/kg) exceeded its ESV (50 mg/kg) and upper background range (83 mg/kg) in the same sample. All other barium and lead results in soils (including subsurface soils) were below background or within the upper background range. Statistically, the elevated barium and lead results in one sample are not representative of nominal site-wide levels. Therefore, these metals are not expected to pose a significant threat to ecological receptors.

Based on the results of the SI, past operations at the Former Probable Range, Parcel 247Q-X, have not adversely impacted the environment. The metals and chemical constituents detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at the Former Probable Range, Parcel 247Q-X.

7.0 References

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ATTACHMENT 1

LIST OF ABBREVIATIONS AND ACRONYMS

APPENDIX A

SAMPLE COLLECTION LOGS AND ANALYSIS REQUEST/CHAIN-OF-CUSTODY RECORDS

SAMPLE COLLECTION LOGS

ANALYSIS REQUEST/CHAIN-OF-CUSTODY RECORDS

APPENDIX B

BORING LOGS AND WELL CONSTRUCTION LOGS

BORING LOGS

WELL CONSTRUCTION LOGS

APPENDIX C

WELL DEVELOPMENT LOGS

APPENDIX D

SURVEY DATA

APPENDIX E

VARIANCE REPORTS

APPENDIX F

SUMMARY OF VALIDATED ANALYTICAL DATA

APPENDIX G

QUALITY ASSURANCE REPORT FOR ANALYTICAL DATA

APPENDIX H

SUMMARY STATISTICS FOR BACKGROUND MEDIA, FORT McCLELLAN, ALABAMA